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Improvements in or relating to the Manufacture of Malt Liquors.

[*Communicated from abroad by William Thomas Jebb, of Buffalo, New York, United States of America, Gentleman.*]

PROVISIONAL SPECIFICATION.

I, WILLIAM ROBERT LAKE, of the firm of Haseltine, Lake, & Co, Patent Agents, Southampton Buildings in the County of Middlesex do hereby declare the nature of my invention for "IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF MALT LIQUORS" to be as follows:—

This Invention relates to improvements in the manufacture of malt liquors, such as beer or ale, from barley malt and the starch derived from Indian corn or maize. A kernel of Indian corn consists of three principal parts, viz: the inner portion or body which consists principally of starch cells; the outer enclosing hull and its glutinous lining which consists of wood fibre, gluten or nitrogenous compounds, albumen and oil which are useful for cattle feed; and the germ which is very rich in oil, the latter constituting about seventy per cent of its component parts. The starchy inner portions of the maize are very desirable for brewing beer or ale as they produce a strong and light colored wort, but the hulls, gluten and germs are very objectionable because they not only discolor the wort but also cause the formation of deleterious substances or impurities in the product and impart to it a rank unpleasant taste or flavor and impair its keeping qualities. The object of this invention is to avoid these difficulties.

In practising this invention, the maize is first steeped in a suitable tank at a temperature of about 140 degrees Fahrenheit, for about fifteen hours, whereby the kernels become expanded or swelled. This temperature is maintained by renewing the water from time to time, from a hot-water tank. When the maize has been steeped it will be found that by the combined action of the heat and moisture the starchy body of each kernel has become enlarged and soft; that the germ has become similarly enlarged and tends to separate itself by reason of its oily character from the surrounding portions of the starchy body which has absorbed water, and that the hull has become tough and tends to separate with its glutinous lining from the starchy body and the oily germ. In steeping the maize care must be taken that the temperature does not rise to 155 degrees Fahrenheit, at which temperature the sacks of the starch cells begin to burst and discharge

their contents, which will then adhere to the hulls and germs and render the subsequent separation of the parts difficult, if not impossible. In order to facilitate this separation cold water is introduced into the steep tank after the operation of steeping is completed, whereby the maize is chilled and the hulls are still further toughened and the oily germs further loosened from the surrounding portions of the starchy bodies. The cold water also operates to cool the maize before it is fed to the reducing machine. The water is next permitted to drain off thoroughly from the steeped maize, a period of five hours being usually allowed for this purpose.

The steeped maize after having been thoroughly drained, is next subjected to the action of a reducing machine, consisting preferably of several concentric rows of beaters or whippers revolving at a high speed in opposite directions within an enclosing case. The maize enters the machine through a feed spout near the centre, and after having been acted upon by the beaters, it escapes through a discharge spout. In order to facilitate the discharge of the reduced material from this machine the outer row of beaters is provided with one or more scrapers which prevent the material from adhering to the inner side of the enclosing case of the machine. In this machine the steeped maize is whipped or beaten, whereby the hulls are opened and stripped in large flakes from the inner starchy bodies and from the germs, the starchy bodies being at the same time reduced to fine granules, while the germs are detached from the starchy portions and hulls without being pulverized. The steeped kernels are in this manner reduced into three distinct products, viz: the finely granulated starchy portions, the germs which are considerably larger than these granules, and the still larger flakes of hulls and their glutinous linings. This distinguishes this method of reduction from grinding or crushing operations in which all the constituent parts of the kernels are to a certain extent pulverized or commingled. It will be observed that the maize is reduced in the moist condition in which it comes from the steeping tank and that no water is added in the reducing machine.

The rapidly rotating beaters of the reducing machine keep the material in agitation while passing through the machine and at the same time drive an air current through the machine with the material, whereby the latter is partially dried and relieved from a portion of the moisture which it has absorbed in steeping. This facilitates the operation of detaching the starch particles from the germs and hulls and also serves to cool the material, so that the meal, hulls and germs are separated in a cool state. The drying effect due to the operation of the reducing machine itself may be supplemented by an air current directed into the machine by a suitable fan.

The reduced material is discharged from the machine into the foot of an elevator, and is discharged from the head of the elevator into a receiving hopper.

The reduced material is next sifted so as to separate the fine starchy portions from the hulls and germs. This is effected by a suitable vibrating or rolling screen which receives the material from the said hopper and is preferably clothed for about two-thirds of its length from its head with fine wire cloth which permits the starch granules to pass through, while it retains the germs and hulls and for the remainder of its length with coarse wire cloth which permits the germs to pass through while the hulls escape over the tail of the screen.

A receiver collects the meal which passes through the upper finely clothed portion of the screen. A second receiver collects the germs passing through the lower coarsely clothed portion of the screen, and a third receiver collects the hulls which escape over the tail of the screen. The second and third receivers are separated by a movable partition which can be placed vertically, when it is desired to collect the germs separately, and which can be inclined, when it is desired to mix the germs with the hulls.

If it is desired to reduce the meal to a higher degree of fineness, this may be done by a second reducing mill which receives the meal from the first receiver. The mill preferably employed for this purpose, is known as the "Bogardus" mill

and consists essentially of two serrated or grooved discs having a slight eccentric movement with reference to each other, whereby the gumming or clogging up of the discs by the meal is avoided.

If it is desired to subject the hulls and germs coming from the screen to a further reduction, this can be done by passing the hulls and germs through a third reducing machine constructed like the first reducing machine and delivering the material upon a second screen arranged on one side of the first screen. The meal passes from the second screen into the first receiver while the germs and hulls pass into fourth and fifth receivers which are separated by a movable partition.

A sixth receiver receives the ground material from the second reducing mill, and the ground material is elevated to a receiving hopper by means of an elevator.

A closed developing tank or vessel receives the meal from the last mentioned hopper in which tank the meal is boiled under pressure at a high temperature for the purpose of developing the starch and preparing the same for mashing. The said tank is provided with a revolving agitator or stirrer and with suitable steam pipes, a safety valve and a pressure gauge for regulating the process of developing the starch. In this tank the meal is mixed with water and boiled under pressure of about 40 pounds to the square inch for several hours until the starch has been fully developed. The process of developing the starch proceeds rapidly and uniformly, because the meal under treatment has been freed from the coarse refuse and consists of fine starch granules of uniform size, whereby the heat is enabled to act uniformly upon all the starchy particles under treatment, thereby preventing the formation of lumps or aggregations of partly developed starch, and rendering the mixture much less liable to be scorched, burnt or discolored.

The barley malt is mashed in a mash tub in the usual manner, which tub receives also the developed starch liquid from the developing tank by a pipe. In this tub the barley malt and developed starch are mashed together in suitable proportions which will depend somewhat upon the nature of the product which is designed to be produced. The developed starch is readily converted in the process of mashing, and forms with the barley malt a heavy wort of light color which is free from the objectionable impurities and flavors which are ordinarily found in worts produced by the addition of corn meal to barley malt. When the process of mashing is completed, the wort is drained off from the grains and drawn into a copper or kettle in which it is boiled and in which the hops are added. The boiled wort is then drained through the hops in the hop back and cooled, fermented and further treated or stored in any usual or well known manner.

The beer or ale produced in this manner is of excellent quality, free from any objectionable taste or flavor, and of a very light color, as the coloring ingredients of the maize have been thoroughly removed. This process can also be advantageously employed in the manufacture of dark-colored beer or ale, because the starch meal furnishes a very desirable substitute for a portion of the barley malt ordinarily employed, as it produces a large yield of heavy wort.

The hulls and germs may be utilized as food for cattle either separately or together with the grains.

It is obvious that the arrangement of the parts of the apparatus may be modified in accordance with the space at disposal and the general form or character of the building in which it is placed.

Dated this 21st day of April 1885.

HASELTINE, LAKE & Co.,
For the Applicant.

Improvements in or relating to the Manufacture of Malt Liquors.

COMPLETE SPECIFICATION.

I, WILLIAM ROBERT LAKE, of the firm of Haseltine, Lake & C° Patent Agents, Southampton Buildings, in the County of Middlesex, do hereby declare the nature of my invention for "IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF MALT LIQUORS" and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in the manufacture of malt liquors, such as beer or ale, from barley malt and the starch derived from Indian corn or maize.

A kernel of Indian corn consists of three principal parts, viz: the inner portion or body which consists principally of starch cells; the outer enclosing hull and its glutinous lining which consists of wood fibre, gluton or nitrogenous compounds, albumen and oil which are useful for cattle feed; and the germ which is very rich in oil, the latter constituting about seventy per cent of its component parts. The starchy inner portions of the maize are very desirable for brewing beer or ale as they produce a strong and light coloured wart, but the hulls, gluten and germs are very objectionable because they not only discolour the wart but also cause the formation of deleterious substances or impurities in the product and impart to it a rank, unpleasant taste or flavour and impair its keeping qualities. The object of this invention is to avoid these difficulties.

In the accompanying drawings

Figure 1 is a longitudinal sectional elevation of machinery by which this invention can be carried into practice.

Figure 2 is a longitudinal sectional elevation of the reducing machine.

Figure 3 is a vertical cross section of the same.

Figure 4 is a top or plan view of the separating sieves.

Figure 5 is a vertical section on the line *x*, *x*, Figure 4.

Figure 6 is a sectional view of a kernel of maize drawn to an enlarged scale.

Similar letters of reference indicate corresponding parts in the several figures.

In practising this invention, the maize is first steeped in a suitable tank A, at a temperature of about 140 degrees Fahrenheit, for about fifteen hours, whereby the kernels become expanded or swelled. This temperature is maintained by renewing the water from time to time from a hot-water tank B. When the maize has been steeped it will be found that by the combined action of the heat and moisture the starchy body S of each kernal has become enlarged and soft; that the germ T has become similarly enlarged and tends to separate itself by reason of its only character from the surrounding portions of the starchy body which has absorbed water, and that the hull U has become tough and tends to separate with its glutinous lining from the starchy body and the oily germ.

In steeping the maize care must be taken that the temperature does not rise to 155 degrees Fahrenheit, at which temperature the sacks of the starch cells begin to burst and discharge their contents, which will then adhere to the hulls and germs and render the subsequent separation of the parts difficult, if not impossible. In

order to facilitate this separation, cold water is introduced into the steep tank A after the operation of steeping is completed, whereby the maize is chilled and the hulls are still further toughened and the oily germs further loosened from the surrounding portions of the starchy bodies. The cold water also operates to cool the maize before it is fed to the reducing machine. The water is next permitted to drain off thoroughly from the steeped maize, a period of five hours being usually allowed for this purpose.

The steeped maize after having been thoroughly drained, is next subjected to the action of a reducing machine C consisting preferably of several concentric rows of beaters or whippers *c* revolving at a high speed in opposite directions within an enclosing case c^1. The maize enters the machine through a feed spout c^2 near the centre, and after having been acted upon by the beaters, it escapes through a discharge spout c^3. In order to facilitate the discharge of the reduced material from this machine the outer row of beaters is provided with one or more scrapers c^4 which prevent the material from adhering to the inner side of the enclosing case of the machine. In this machine the steeped maize is whipped or beaten, whereby the hulls are opened and stripped in large flakes from the inner starchy bodies and from the germs, the starchy bodies being at the same time reduced to fine granules, while the germs are detached from the starchy portions and hulls without being pulverized. The steeped kernels are in this manner reduced into three distinct products, viz: the finely granulated starchy portions, the germs which are considerably larger than these granules, and the still larger flakes of hulls and their glutinous linings. This distinguishes this method of reduction from grinding or crushing operations in which all the constituent parts of the kernals are to a certain extent pulverized or commingled. It will be observed that the maize is reduced in the moist condition in which it comes from the steeping tank and that no water is added in the reducing machine.

The rapidly rotating beaters of the reducing machine keep the material in agitation while passing through the machine and at the same time drive an air current through the machine with the material, whereby the latter is partially dried and relieved from a portion of the moisture which it has absorbed in the steeping. This facilitates the operation of detaching the starch particles from the germs and hulls and also serves to cool the material, so that the meal, hulls and germs are separated in a cool state. The drying effect due to the operation of the reducing machine itself may be supplemented by an air current directed into the machine by a suitable fan.

The reduced material is discharged from the machine C into the foot of an elevator D, and is discharged from the head of the elevator into a receiving hopper E.

The reduced material is next sifted so as to separate the fine starchy portions from the hulls and germs. This is effected by a suitable vibrating or rolling screen F which receives the material from the hopper E and is preferably clothed for about two-thirds of its length from its head with fine wire cloth which permits the starch granules to pass through, while it retains the germs and hulls; and for the remainder of its length with coarse wire cloth which permits the germs to pass through while the hulls escape over the tail of the screen.

G represents a receiver which collects the meal which passes through the upper finely clothed portion of the screen F. H is a receiver which collects the germs passing through the lower coarsely clothed portion of the screen, and I a receiver which collects the hulls which escape over the tail of the screen. The receivers H and I are separated by a movable partition *h* which can be placed vertically, as shown in full lines in Figure 1, when it is desired to collect the germs separately, and which can be inclined, as shown in dotted lines, when it is desired to mix the germs with the hulls.

If it is desired to reduce the meal to a higher degree of fineness, this may be done by a suitable mill K, which receives the meal from the receiver G. The mill

preferably employed for this purpose, is known as the "Bogardus" mill and consists essentially of two serrated or grooved discs having a slight eccentric movement with reference to each other, whereby the gumming or clogging up of the discs by the meal is avoided.

If it is desired to subject the hulls and germs coming from the screen F to a second reduction, this can be done by passing the hulls and germs through a second reducing machine constructed like the machine C and delivering the material upon a second screen F^1 arranged on one side of the screen F. The meal passes from the screen F^1 into the receiver G, while the germs and hulls pass into receivers H^1 and I^1 which are separated by a movable partition h^1.

L is a receiver which receives the ground material from the mill K; and M is an elevator whereby the ground material is elevated to a receiving hopper P.

Q represents a closed developing tank or vessel which receives the meal from the hopper P and in which the meal is boiled under pressure at a high temperature for the purpose of developing the starch and preparing the same for mashing. The tank Q is provided with a revolving agitator or stirrer and with suitable steam pipes, a safety valve and a pressure gauge for regulating the process of developing the starch. In this tank the meal is mixed with water and boiled under pressure of about 40 pounds to the square inch for several hours until the starch has been fully developed. The process of developing the starch proceeds rapidly and uniformly, because the meal under treatment has been freed from the coarse refuse and consists of fine starch granules of uniform size, whereby the heat is enabled to act uniformly upon all the starchy particles under treatment, thereby preventing the formation of lumps or aggregations of partly developed starch, and rendering the mixture much less liable to be scorched, burnt or discolored.

R represents the mash tub in which the barley malt is mashed in the usual manner, and which receives also the developed starch liquid from the tank Q by a pipe *q*.

In this tub the barley malt and developed starch are mashed together in suitable proportions which will depend somewhat upon the nature of the product which is designed to be produced. The developed starch is readily converted in the process of mashing and forms with the barley malt a heavy wort of light colour which is free from the objectionable impurities and flavours which are ordinarily found in worts produced by the addition of corn meal to barley malt.

When the process of mashing is completed the wort is drained off from the grains and drawn into the copper or kettle S^1 in which it is boiled and in which the hops are added. The boiled wort is then drained through the hops in the hop back S^2 and cooled, fermented and further treated or stored in any usual or well known manner.

The beer or ale produced in this manner is of excellent quality, free from any objectionable taste or flavour, and of a very light colour, as the colouring ingredients of the maize have been thoroughly removed. This process can also be advantageously employed in the manufacture of dark-coloured beer or ale, because the starch meal furnishes a very desirable substitute for a portion of the barley malt ordinarily employed, as it produces a large yield of heavy wort.

The hulls and germs may be utilized as feed for cattle either separately or together with the grains.

It is obvious that the arrangement of the parts of the apparatus may be modified in accordance with the space at disposal and the general form or character of the building in which it is placed.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed as communicated to me by my foreign correspondent I declare that what I claim is

First. The herein described method of producing a wort suitable for the manufacture of beer or ale, which consists in freeing the starchy portions of the

kernels of Indian corn or maize from the hulls and germs by steeping, whipping and sifting, and then mashing the separated starchy material together with barley malt and draining off the wort, substantially as set forth.

Second. The herein described method of producing a wort suitable for the manufacture of beer or ale, which consists in freeing the starchy portions of the kernels of Indian corn or maize from the hulls and germs by steeping, whipping and sifting, then boiling the separated starch to develop the same, and then mashing the developed starch together with barley malt and draining off the wort, substantially as set forth.

Dated this 23rd day of July 1885.

HASELTINE, LAKE & Co.,
For the Applicant.

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For Her Majesty's Stationery Office.

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FIG. 1.

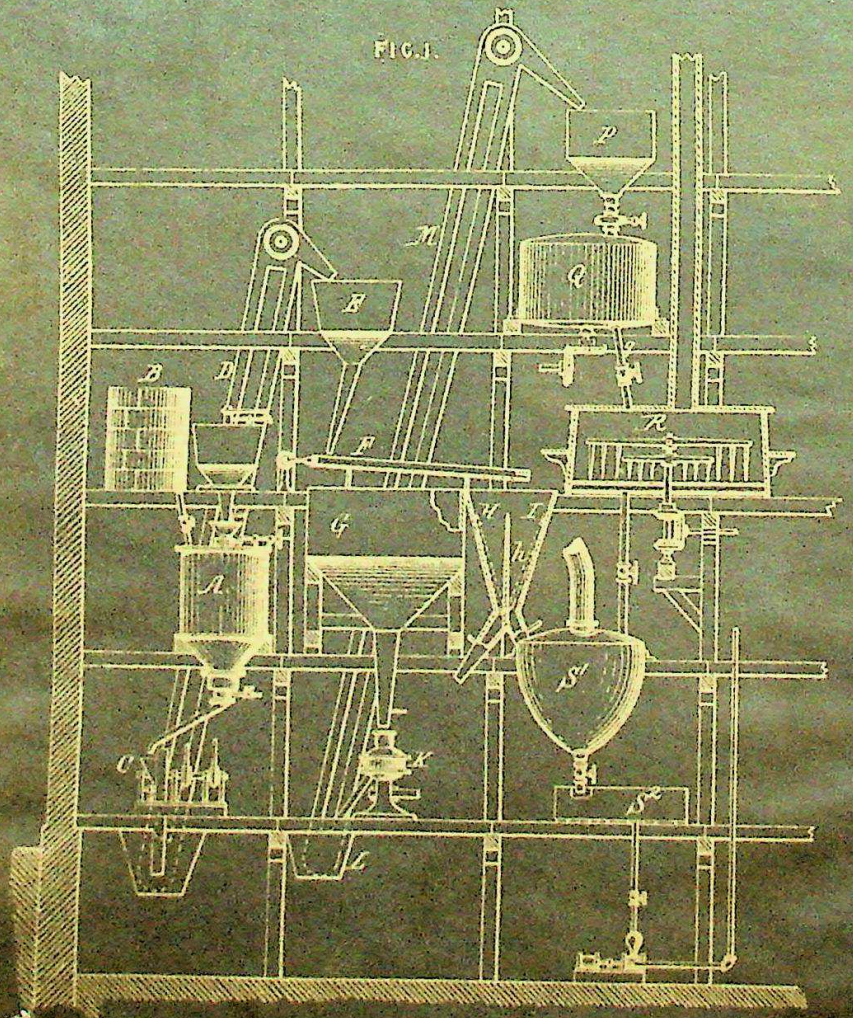

FIG. 4.

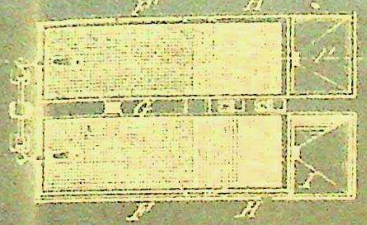

FIG. 6.

FIG. 5.